AN ASSESSMENT OF WIND EROSION ON EYRE PENINSULA DURING 1988/89

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDIX

1. INTRODUCTION

Much of Eyre Peninsula has a high potential for wind erosion due to its environmental constraints. Annual rainfall varies from 275mm in the most western, eastern and northern parts of the peninsula that have been cleared for agriculture, up to around 500mm in the south. As a rough guide wind erosion occurs in districts with rainfall less than 400mm and soils which are relatively sandy in nature. The most common annual rainfall on Eyre Peninsula in these areas is between 300 and 325mm. Soils are predominantly aeolian in nature varying from calcareous sands and sandy loams in the west to siliceous dune swale complexes with some heavier textured soils associated with igneous or metamorphic rocks more common in the east.

Eyre Peninsula is primarily a cereal sheep area and produces around 40% of South Australia's wheat, 22% of the State's barley and 14% of the State's wool clip. In good seasons this proportion of wheat production increases to 50% of the State and around 10% of the wheat production in Australia.

Wind erosion on Eyre Peninsula has been widespread once or twice each decade since clearing commenced. In 1977/78 the erosion was considered to be the worst since the 1930's.

In 1978, Wetherby et al.(1) assessed the level of wind erosion on Eyre Peninsula following the 1977 drought and the preceding dry seasons. At the height of the drought 165,000 hectares of arable land were affected by wind erosion. Factors considered to have contributed significantly to the severity of the problem included an ill defined start to the 1977 season, water repellence on the siliceous sands, overstocking, excessive cultivation associated with the use of pre-emergent herbicides and unsuitable cereal cultivars for the sandier soils.

In 1988, seasonal conditions on Eyre Peninsula were amongst the driest on record, resulting in widespread erosion in many districts. The situation was aggravated by severe financial problems being faced by many farmers brought on by a series of poor seasons, high interest rates and excessive debt which resulted in risky management practices.

During September 1988 the Eyre Region Department of Agriculture worked with the Central and Eastern Eyre Peninsula Soil Conservation Boards to record and assess the extent and severity of wind erosion. The assessment was made aerially using the same flight path and method as used by Wetherby et al. in 1978 to allow direct comparisons.

This publication records and comments on the severity and extent of the wind erosion and the factors which influenced it. Recommendations are made about future directions required to reduce wind erosion, not only in drought conditions, but in all seasons - the situation has been assessed and it is important we learn from it.

2. EXTENT OF WIND EROSION

2.1 Method of Aerial Survey

Aerial survey was used to determine the extent and severity of wind erosion. The flight in January 1989 covered Upper and Western Eyre Peninsula following the same path as that conducted by Wetherby et al. in 1978. The flight path for the survey is shown in figure 1.

.../2

A Cherokee Archer plane was used flying at 2,000 to 5,000 feet depending on conditions. The flight path as shown took ten hours flying time and was conducted over two days. The crew required for the flight included the pilot and three observers. The observers were rotated with the ground crew to ensure a 'local' was on board at all times to provide control information.

The survey area was divided into units, bounded by roads, tracks, railway lines, scrub lines or other recognisable geographic features. Each unit was assessed regarding the percentage of land affected by drift as per Wetherby et al.(1) 1983. This report does not distinguish drift types due to problems in some districts in making the distinction.

An area was considered to be suffering from wind erosion or drift if it appeared bare with evidence of saltation of soil particles. These areas were easily detected from adjacent stable areas.

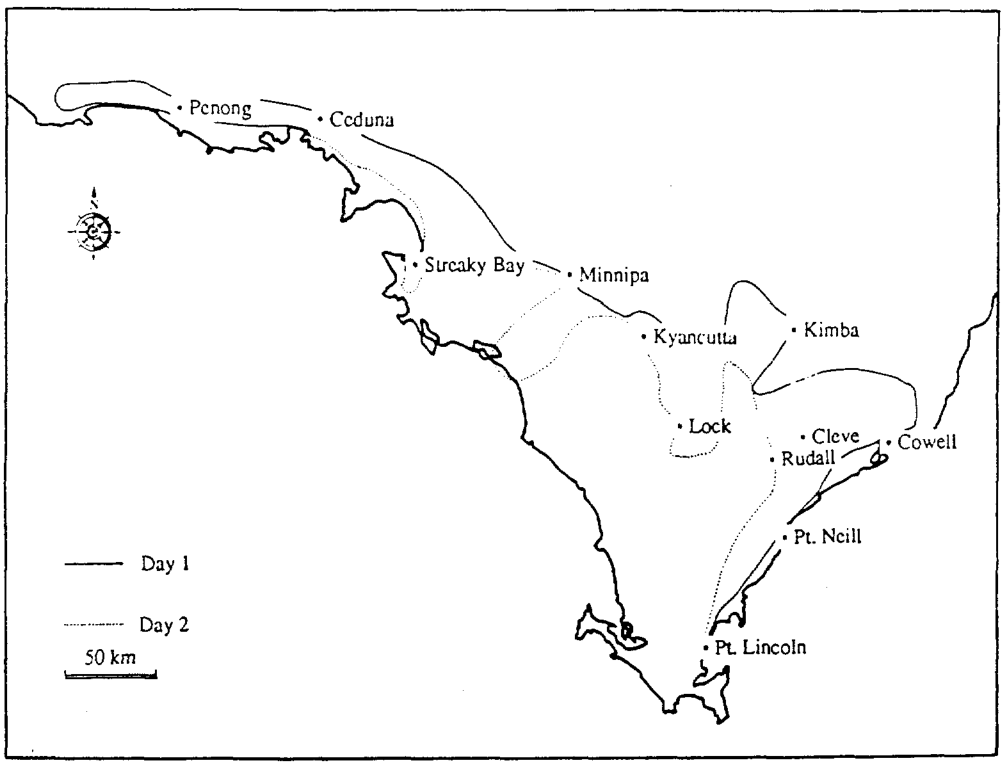


Figure 1: Flight path of aerial survey.

After surveying, the area of each unit was calculated from the series of 1:250,000 topographic maps used for the survey (see figure 2) and the area of native vegetation subtracted from the total area giving the area of cleared land. The percentage of this area affected by drift was then calculated. Experience has shown that this method of aerial visual assessment is both more cost effective and accurate than satellite imagery.

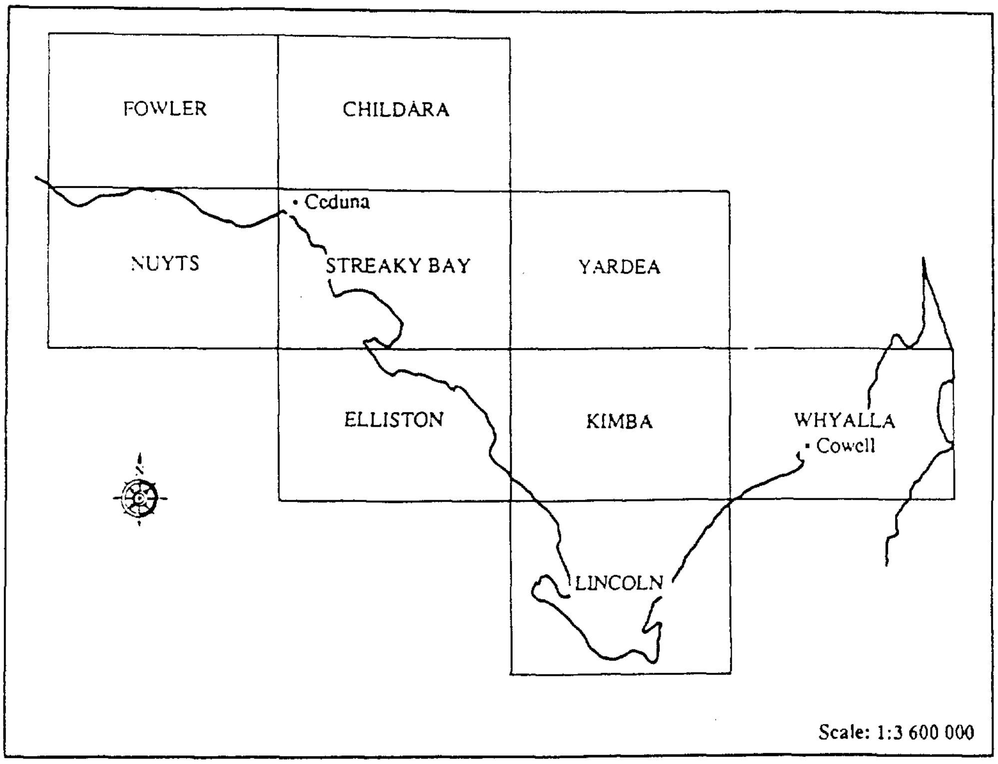


Figure 2: Index of 1:250,000 maps.

2.2 Results of Aerial Survey

The extent of the main areas of wind erosion on Eyre Peninsula are shown in figure 3. Where wind erosion was occurring over greater than 4% of the survey unit it was considered significant.

The major areas of severe drift were the areas north, west and south of Cowell, the Kyancutta and Wudinna districts and the area north and west of Ceduna. The total area drifting on each map sheet can be seen in table 1.

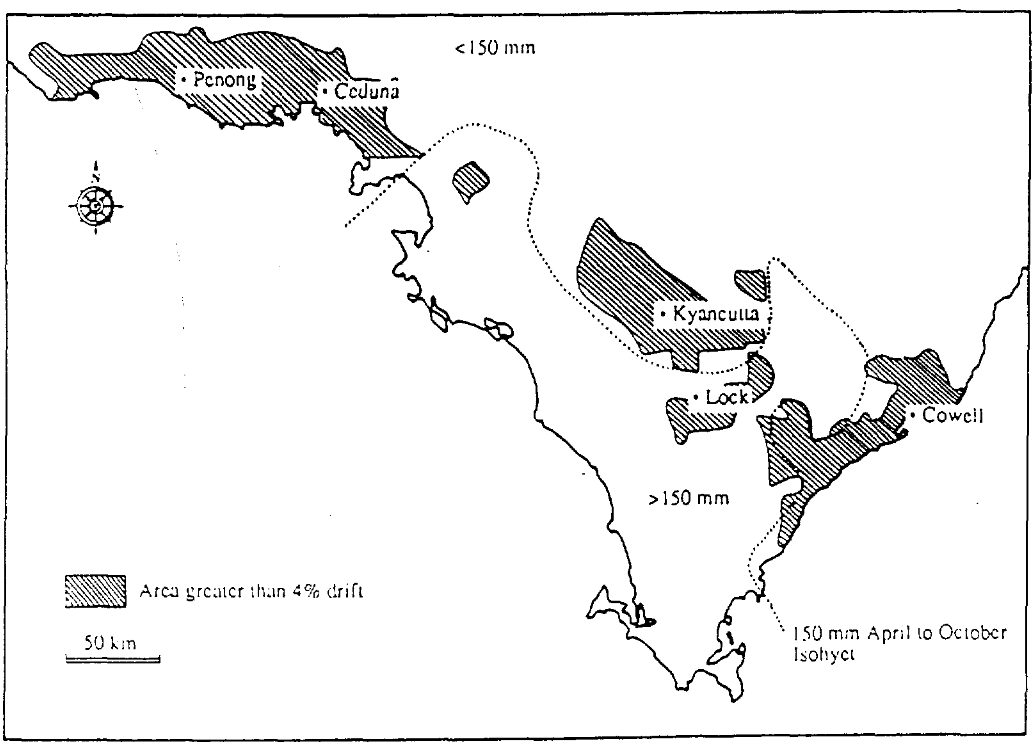


Figure 3: Extent of drift on Eyre Peninsula, January 1989.

TABLE 1: Summary of drift during 1988/89 based on 1:250,000 mapsheets.

Mapsheet	Drift (ha)	Total Area Cleared (ha)	% Drifting
Lincoln	5,727	98,353	5.8
Whyalla	41,055	161,355	25.4
Kimba	60,058	713,350	8.4
Yardea	9,188	169,500	5.4
Streaky Bay	43,085	557,342	7.7
Childara	24,258	44,550	54.5
Fowler	38,335	123,000	31.2
Nuyts	12,245	39,350	31.1
Elliston	400	42,000	0.9
	234,351	1,948,800	12.0

In total 234,000 hectares were drifting representing 12% of the cleared area.

The area west of Ceduna had up to 30% of the land affected by drift. Some units within this area had up to 90% of the cleared land affected by drift. The area around Cowell had similar damage with some units having up to 90% of the cleared land being affected in some instances.

The degree of wind erosion can be seen in figure 4 with the most severely affected areas showing greater than 15% drift. The 150mm April to October rainfall isohyet as outlined for 1988 highlights the most severely affected areas which all occur where growing season rainfall was less than 150mm. (Note: Growing season rainfall or the April to October rainfall isohyet refers to the sum of the monthly totals from April to October).

2.3 Severity of Damage

The evident damage to the soil caused by the wind erosion varied markedly between districts and even between paddocks. There were many cases where damage seemed relatively superficial and soil loss minimal. However, there were also cases where soil losses of up to 15cm occurred over relatively large patches within paddocks. In these instances the productive surface soil has essentially been destroyed. Approximately 10% of the area classed as drifting has had long term productivity seriously affected, with the remainder suffering minor topsoil loss.

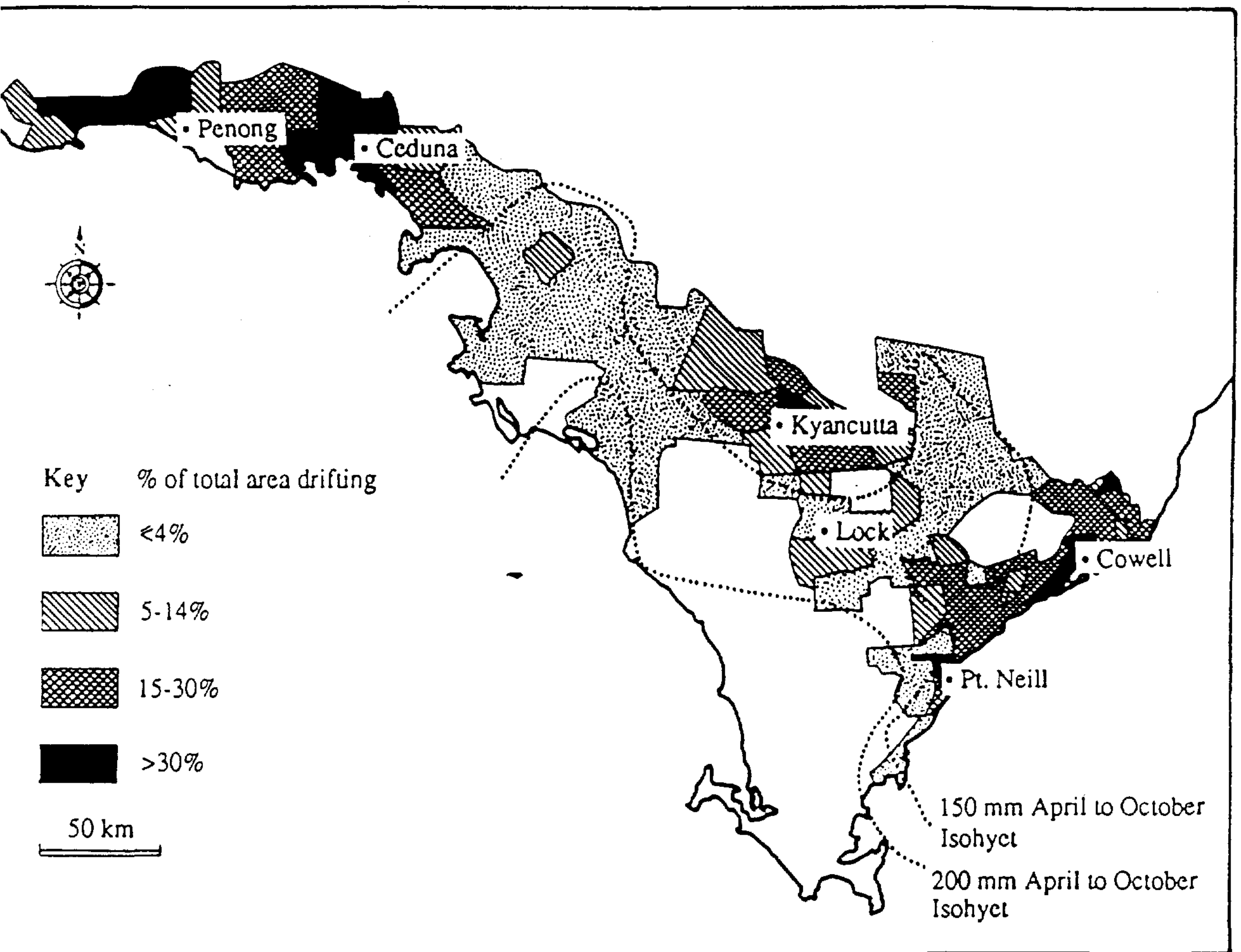


Figure 4 - Degree of wind erosion on Eyre Peninsula, January 1989.

.4 Other Indicators

Other than broadacre "sweeping" and erosion on farms, wind erosion also impacted upon local communities in other ways.

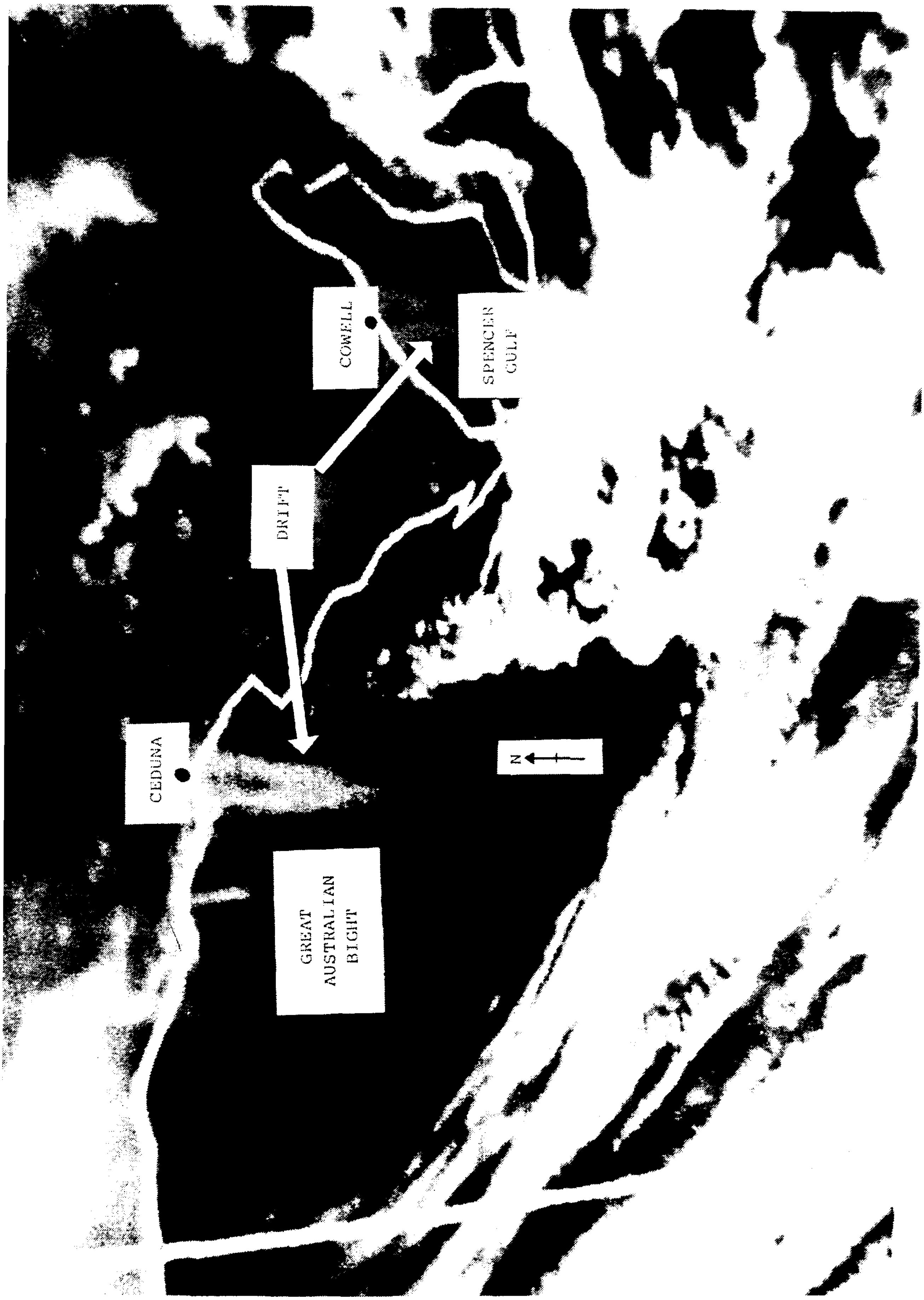
For example, the District Council of Franklin Harbour estimated that by December 1988, 55km of roads in the district had been affected by drift to some degree (2). Approximately 40km were badly affected, or became impassable, and a further 15km were assessed as having the potential to become badly affected. This resulted in an estimated cost of up to $250,000 for road repairs which is more than 50% of the Council's normal rate revenue. This was the cost to the community for just one of the seven Council districts affected by drift.

These costs are in addition to the direct cost of damage on farms and future direct and indirect costs of soil losses.

.../6

Photograph 1 - Closed road south of Ceduna.

The severity of the drift was recorded by satellite photographs taken for weather forecasts on 7th November 1988 when extreme wind conditions, (see 3.1.2) blew fine material up to 200km into the Great Australian Bight. On photograph 2 the soil materials can be seen coming from the Ceduna area into the Bight and from the area near Cowell into Spencer Gulf.



Photograph 2 - Satellite image on 7th November, 1988 showing soil materials blown south from Eyre Peninsula to the Great Australian Bight.

.../8

3. FACTORS INFLUENCING THE SEVERITY AND EXTENT OF WIND EROSION IN 1988

The severity of the wind erosion during 1988/89 was the result of many factors, some under land management control, others due to severe environmental conditions.

3.1 Environmental Factors

3.1.1 Drought Conditions

Rainfall figures for centres on Eastern and Upper Eyre Peninsula during the growing season (April to October) 1988 reflect the extreme drought conditions experienced.

Growing season rainfall and deciles for all centres on Eyre Peninsula are shown in appendix 1. At Penong and Koonibba (west of Ceduna), April to October rainfall was the lowest on record, while at Cowell, April to October rainfall was the second lowest on record.

In districts severely affected by wind erosion rainfall was generally less than 115mm during the growing season. Table 2 shows the rainfall of centres within severely affected areas.

TABLE 2(a): Rainfall, mean monthly and decile rankings recorded at selected centres in severely affected areas during 1988.

Centre	Monthly Rainfall (mm)												
	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
COWELL, Post Office (Recording period 1885 to 1989)													
1988	2	6	15	1	20	27	4	6	13	11	33	15	153
Mean	14	19	18	27	30	28	26	27	28	28	20	16	280
Decile Ranking	2	5	7	1	5	6	1	1	3	2	8	5	1
KYANCUTTA, Post Office (Recording period 1930 to 1989)													
1988	12	1	17	0.8	26	33	24	6	13	5	20	41	199
Mean	12	17	13	20	35	39	42	40	32	27	22	19	319
Decile Ranking	7	3	8	1	4	5	2	1	3	2	6	9	1
PENONG, Post Office (Recording period 1892 to 1989)													
1988	13	19	4	2	32	14	33	4	18	3	9	33	184
Mean	9	17	16	24	42	44	46	43	29	25	19	15	328
Decile Ranking	8	8	4	1	4	1	4	1	4	1	4	9	1

NOTE: Decile ranking 1 refers to the range of driest 10% of rainfalls, decile 2 the next driest 10% of rainfalls and so on up to decile 10.

.../9

TABLE 2(b): Mean and decile rankings for three periods over the growing season.

Groupings	Rainfall (mm) April-May	June-August	September-October	April-October
COWELL				
1988	21	37	24	82
Mean	57	81	56	195
Decile Ranking	2	1	2	1
KYANCUTTA				
1988	26.8	63	18	107.8
Mean	56	122	58	235
Decile Ranking	3	1	1	1
PENONG				
1988	34	51	21	106
Mean	66	133	54	253
Decile Ranking	2	1	2	1

The distribution of rainfall during the season contributed to the problem, as reasonable rains in May (eg. Decile 4 at Kyancutta) and in June at some centres gave hope to farmers of a reasonable season to come. In fact in some districts in 1988 the May rains represented the best start farmers had experienced since 1983.

As wool returns were good, many farmers retained their stock in the face of worsening drought conditions, as well as increasing cropping areas. These, combined with poor pastures, led to overstocking and eventually erosion.

Below average rainfall in previous years was a contributing factor to the severity of wind erosion experienced in 1988. Poor crop and pasture growth in these years resulted in very low levels of organic matter and therefore very little protection for the soil.

In addition, tight economic factors had led to a narrowing of cropping frequency over large tracts of country which were unable to take the increased tillage.

The poor seasons in the lead up to 1988 are summarised in table 3.

In 1986, damage to crops by frost severely reduced yields in some districts further adding to the economic problems.

TABLE 3: Annual and growing season rainfall (mm) for 1985 to 1988.

	1985	1986*	1987	1988	Mean for all recording years
Pt. Neill					
Annual Rainfall	324	214	234	254	322
Growing Season	248 (6)	182 (3)	162 (2)	146 (1)	240
Cowell					
Annual Rainfall	278	242	242	153	280
Growing Season	222 (7)	206 (6)	145 (3)	82 (1)	195
Cleve					
Annual Rainfall	353	351	304	319	397
Growing Season	280 (5)	317 (7)	191 (2)	183 (1)	291
Kyancutta					
Annual Rainfall	242	255	234	194	319
Growing Season	205 (4)	199 (3)	149 (1)	108 (1)	235
Minnipa					
Annual Rainfall	315	328	259	206	348
Growing Season	257 (6)	288 (7)	168 (2)	129 (1)	262
Ceduna					
Annual Rainfall	247	281	230	224	292
Growing Season	205 (5)	252 (8)	144 (2)	112 (1)	217
Penong					
Annual Rainfall	212	212	249	184	330
Growing Season	175 (2)	279 (7)	143 (1)	106 (1)	253

Decile Ranking in Brackets

* Severe damage to crops by frost occurred in some districts this year.

3.1.2 Wind Conditions

Wind conditions during winter and spring of 1988 contributed to the severity of drift. The percentage occurrence of different velocity winds at Cleve from July to December 1988 in comparison with mean figures are shown in appendices 2 and 3. These figures highlight the higher than average incidence of medium strength winds and the low incidence of calmer conditions through 1988.

On 7th November an extremely severe wind storm greatly increased the area of sweeping drift, as well as devastating many barley crops. During the morning of 7th November, wind at Cleve gusted up to 100km/hr (3), prevailing for 24 hours. At the time of recording the wind at Cleve had reduced in velocity hence this particular storm does not show up in appendix 3. The severity of the storm throughout Eyre Peninsula was such that both the Lincoln and Eyre Highways had sections closed (see photograph 3).

Photograph 3 - Dust in the air south of Cowell on a moderate day.

3.1.3 Soil Types

The areas severely affected by wind erosion could be identified by rainfall distribution alone with soil type making little difference. Sandy loam and loam soils around Elbow Hill and Wudinna were drifting as much as the sands and loamy sands.

In the less severely affected areas however, sandy ridges and sandy paddocks suffered worse erosion than adjacent loamy soils (see photograph 4).

Photograph 4 - Drifting sand rises north of Rudall.

3.2 Economic Conditions

Farmers on Upper and Eastern Eyre Peninsula had been experiencing low grain prices, increasing higher interest rates and high indebtedness in the lead up to 1988. This combined with the relatively poor seasons, especially in some districts, prompted many farmers to take large risks in 1988. The reasonable start to the season gave some optimism about the season and many farmers aimed to sow as much of their property as possible in an effort to accelerate cash flow. Farmers were also keen to maintain sheep numbers, as returns from wool were high during 1988. The net result, due to worsening seasonal conditions, was one of overcropping and overgrazing in many situations.

Feedback from farmers and District Soil Conservation Boards was that the drastic economic situations being faced by farmers was a most significant factor in the use of risky land management practices. They were aware of potential outcomes but on the hope of a good season to relieve indebtedness, progressed anyway.

A measure of the financial stress being faced by farmers at this time is that between July 1988 and March 1989, 289 out of the 1,800 farmers on Eyre Peninsula applied for some form of Rural Assistance.

In 1988 no direct Government aid was available to farmers for livestock maintenance. This was in contrast to previous droughts where freight and hay subsidies were available. In some situations this led to overgrazing of paddocks by farmers who were unable to afford to send stock on agistment or purchase fodder.

3.3 Effect of Management

The severity of the erosion varied markedly with management practices. This was more noticeable in the less severe areas rather than the "hot spots" where a very high percentage of paddocks were affected and severe environmental conditions outweighed the effects of management. The following observations on management were made during "on-ground" follow-up and discussions with District Soil Conservation Boards, farmer groups and individual farmers.

3.3.1 Tillage Practices

(a) Sowing Time

In districts with low levels of drift the benefits of early sowing were highlighted. Clear differences existed between farms where the crop was sown early and those where it was sown two weeks later. Early sown crops were able to establish and make use of available moisture, where as later sown crops suffered reduced growth due to colder conditions and moisture stress. These later sown crops were subsequently severely damaged by wind, which led quickly to drift as the drought set in (see photograph 5).

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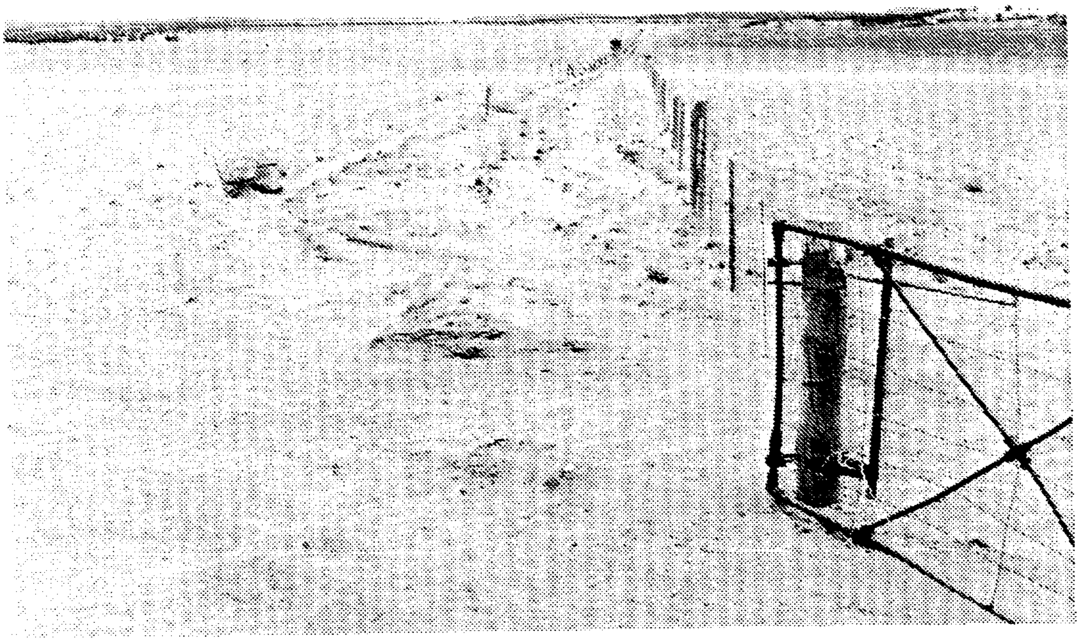
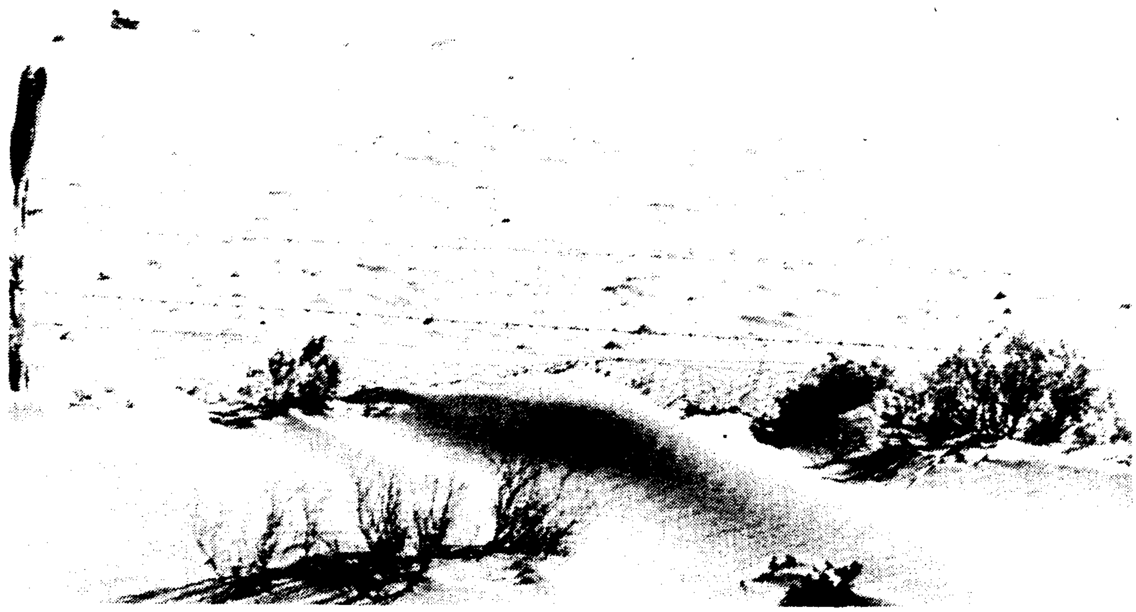


Photograph 5 - Difference between surface stability on properties with different sowing times north of Cowell. (Note - drift on the property on the right (earlier sown) is coming from the property on the left.)

(b) Dry Cultivation

A major factor determining the amount of drift around Ceduna was the practice of dry cultivation. In recent times, farmers in this area have used a dry cultivation in an attempt to improve timeliness of operations given late seasonal breaks. This has enabled them to sow around the optimum time, with just enough moisture to ensure germination. In 1988 this practice resulted in many paddocks being cultivated and not sown as there was insufficient rain and soil moisture. Some paddocks that were sown dry either did not germinate or had very weak emergence and were subsequently cut by wind blown soil (see photograph 6).



Photograph 6 - Crop cut by wind blown soil near Ceduna.

(c) Minimum Tillage

In the less severely affected areas farmers who used minimum tillage techniques generally had better cover and crops. This was especially so on the water repellent sands where the extent of erosion was well down on the 1977 drought at which time cultivation was the main weed control technique and consequently more intense.

However, there were examples of farmers who used minimum tillage, had no stock and still had significant areas of crop blown out in the areas with the most severe environmental conditions.

Very few areas of direct drilling were recorded in 1988, as farmers are wary of potential root disease problems with this technique. However, where tried in 1988, direct drilling was successful in avoiding severe wind erosion.

(d) Grass Removal

Grass removal from pastures was a significant factor in pasture paddocks being affected by drift. In the severely affected areas the only stable pasture paddocks tended to be those invaded by a non-palatable weed (eg onion weed) or those with adequate levels of stubble from the 1987 season.

In situations where residual sulfonyl urea herbicides had been used on alkaline soils, reduced pasture growth increased the potential for wind erosion.

The implication of this is that farmers who wish to practice grass reduced farming in the marginal districts must monitor paddocks very closely to ensure stock removal occurs while there is still enough bulk left to ensure a cover at the end of the growing season. In a season like 1988 this would have meant complete stock removal in winter to a feedlot, agistment or sale.

(e) Grain Legumes in Low Rainfall Districts

Unfortunately, in 1988 where grain legumes crops were being grown in low rainfall areas which received decile 1 growing season rainfall the common result was a drifting paddock. The effect of the "good" management practice of complete grass removal from grain legume crops left the soil vulnerable to wind erosion of the soil. The benefits gained by growing grain legumes, such as improved soil health and fertility, were quickly lost when paddocks start drifting.

In the future it seems a good sustainable land management policy is to concentrate on legume based pastures in low rainfall areas leaving grain legumes for better soils, in wetter districts.

3.3.2 Grazing Management

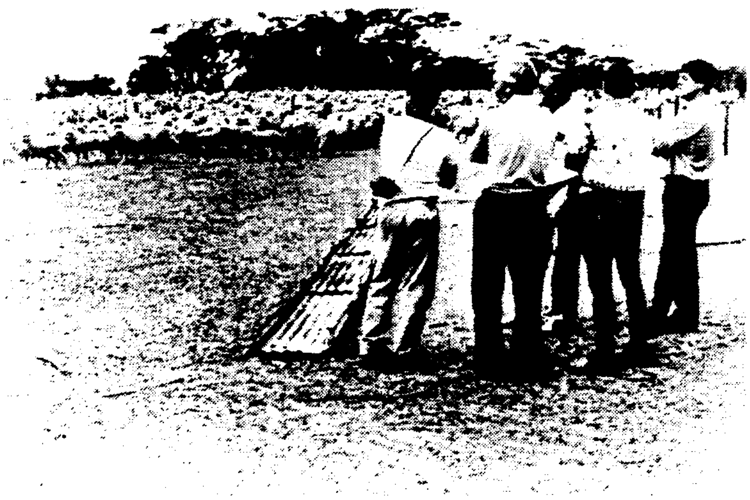
Overall it was considered that grazing management was a very significant factor in the degree of erosion experienced in the Cowell and Kyancutta districts. Overgrazing of pastures and grazing of failed crops accounted for many of the drifting paddocks in these areas. At Cowell this occurred even though the local Agricultural Bureau had a meeting in early September which emphasized the economic benefits of feedlotting. The good economic return from sheep was the major reason why farmers were reluctant to reduce numbers and feedlotting was not generally accepted as an alternative to open paddock grazing.

The 1988 season highlighted that the grazing of failed crops can be a dangerous practice. Limited feed was available from the crop and the surface soil quickly became loose and vulnerable to wind erosion. The only stable cropping paddocks in the badly affected areas occurred where no sheep had been grazed after sowing (see photograph 7).

.../16

Photograph 7 - Ungrazed failed cereal (foreground) vs grazed failed cereal (background), Wudinna.

On a positive side, by January 1989, 150 farmers on Eyre Peninsula had set up feedlot units in which to transfer sheep in tough conditions. Ashton et al.(4) recently completed an analysis of feedlot use during 1988/89 which reports favourably on sheep health and growth while they are maintained in feedlots (see photograph 8).



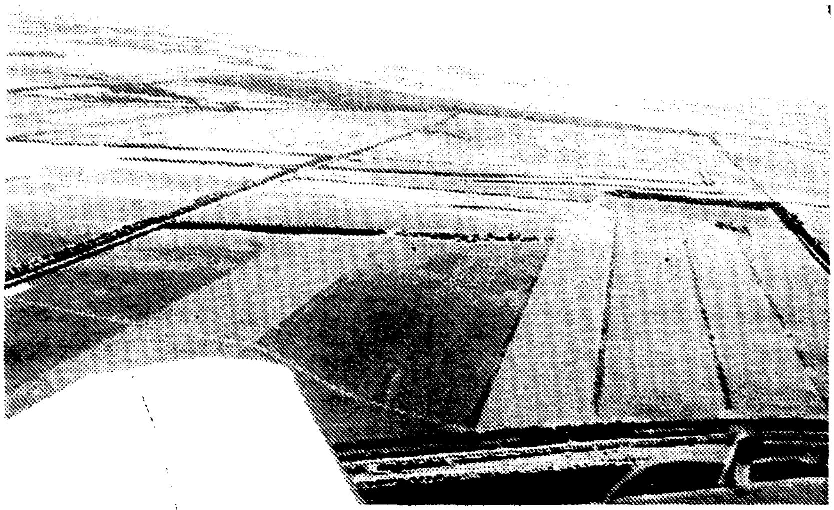
Photograph 8 - Feedlot west of Ceduna.

3.3.3 Land Use Capability

A proportion of the land that drifted in 1988 is a continuing problem because the land is not suited to cropping. This was especially the case with deep sandy soils ($>$ 75cm deep) that were cropped with wheat and barley. These deeper siliceous sands occur as part of the parallel or jumbled siliceous sand ridges over much of Eyre Peninsula and need to be either sown with cereal rye or established to permanent pastures or shrubs.

In some cases paddock re-design is desirable to separate more erosion prone soils from those at less risk. Establishment of windbreaks around paddocks and adjacent to public areas (eg. fringe town dwelling) would further reduce the impact of droughts and subsequent wind erosion (see photograph 9).

Overcropping of sandy soils is considered an unsuitable land use. In 1988 sandy paddocks, especially around Ceduna, were cropped two or more years in a row in an attempt by farmers to pull themselves out of debt. The long term effect of this is to make these paddocks more vulnerable to drift.



Photograph 9 - S. Jericho's at Rudall showing windbreaks, farm plan and stable paddocks.

4. FARMER AWARENESS

The farming and general communities became well aware of the wind erosion problem that occurred in 1988 as the drought received considerable media coverage. Districts in the Far West of Eyre Peninsula also received attention from the media due to the financial problems of many landholders.

The Advisory Committee on Soil Conservation and District Soil Conservation Boards in affected areas have inspected eroded areas (see photo 10).

.../18

Photo 10: Advisory Committee on Soil Conservation and Eastern Eyre Peninsula Soil Board inspecting erosion north of Cowell.

Consultation with affected landholders has been positive and in the Wudinna and Elbow Hill districts ripping to prevent active drift was a widespread practice. In some cases however winds were extreme and topsoil between riplines was completely removed.

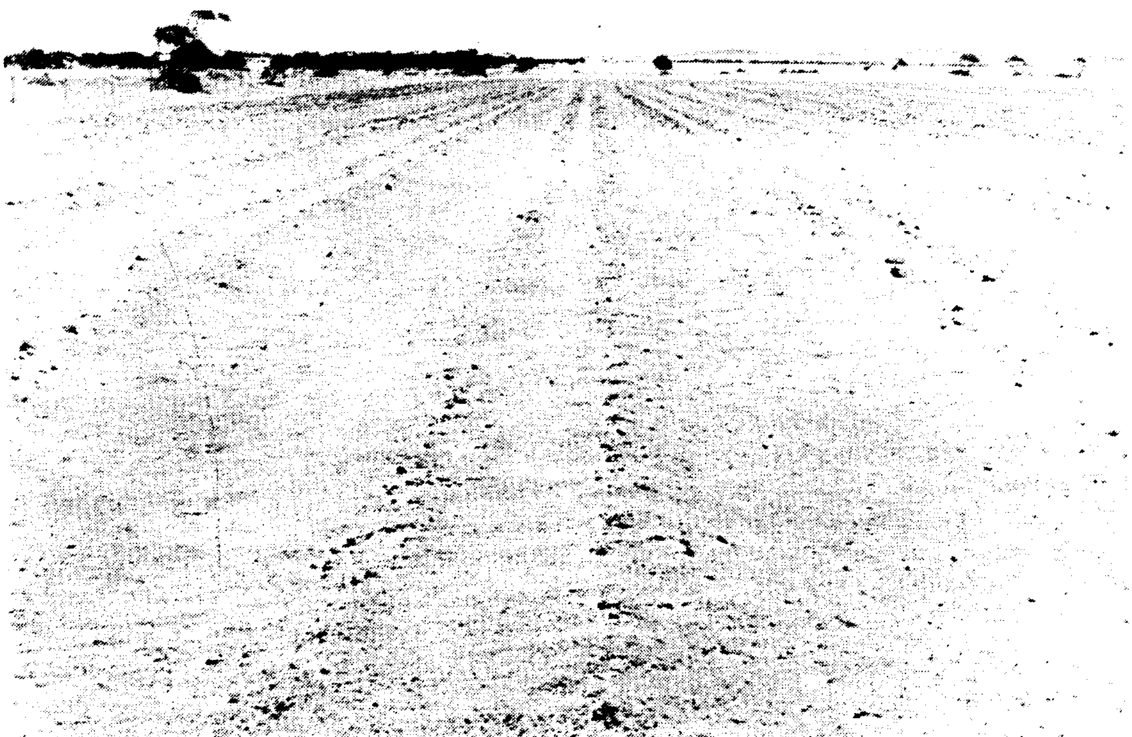
An example of ripping and the effect of the wind is seen in photos 11 and 12.

The Department of Agriculture has given considerable extension effort into the technique of lot feeding sheep to get them out of the paddock. This effort has been worthwhile with over 500 sheep feeding kit booklets being sold predominantly in the affected districts. Landholders in districts not severely affected by drift have also purchased booklets, as they see feedlotting as a useful management tool that can be used regardless of drought. Field days and evening talks to Agricultural Bureau groups have been numerous and well attended by landholders. However, the introduction of feedlots has been slow, with only 150 established during 1988/89.

Harvest report meetings with Bureau groups have involved discussion of the results of this survey, the causes of the drift and directions that should be taken by landholders in the 250-400 mm rainfall districts to prevent drift in the future.

.../19

Photograph 11: Ripped paddock at Elbow Hill.



Photograph 12: Same paddock following wind on 7th November 1988.

5. COMPARISON WITH THE 1977 DROUGHT

Hughes et al.(5) compared the wind erosion of 1977 with that which occurred in 1988. The two droughts largely differed in the areas affected by drift (see appendix 4 - Extent and severity of drift on Eyre Peninsula, May 1978). There were differences in some of the factors which influenced the degree of erosion.

For example, the effects of rainfall distribution, influence of water repellancy, soil types effected, extent of excessive cultivation and the effect of wind breaks around paddock boundaries (see later) seemed to vary considerably between the two droughts.

Factors considered significant but common to both events included economic stress, late sowing, overgrazing, lack of land capability planning and problems associated with adoption of new weed control technology.

6. SUMMARY

Obviously, the major factors leading to wind erosion on Eyre Peninsula in 1988 were the severe environmental conditions. Briefly these were severe drought conditions and strong winds especially in October and November. In addition, 1987 had been very dry and in many centres 1985 and 1986 as well. Rainfall distribution created some optimism early, which led to overcropping and overstocking.

For the farmers exposed to these conditions management decisions which would reduce soil damage were crucial. Many farmers were under enormous financial stress which led to some risky management decisions and subsequent soil damage. The drought highlighted problems with current management systems in the broad areas of tillage systems, livestock management and land capability planning.

7. FUTURE DIRECTIONS

The goal of farmers on Eyre Peninsula are to have sustainable land use practices which optimize productivity in good seasons but which allow soil protection in the droughts.

To achieve this farmers need continued support from Government agencies, Soil Conservation Boards and local communities to provide resources, technology and encouragement. The new soil conservation legislation in South Australia highlights land degradation as a whole community problem and provide for a more planned approach to its control. Federally, the National Soil Conservation Programme is expanding as community awareness of land degradation rises. Farmers, farmer groups and agencies on Eyre Peninsula need to tap into this programme to enable them to carry out research, demonstrate, adapt and extend technology that will reduce the potential for erosion not only in the next drought, but in all seasons.

Environmental conditions on Eyre Peninsula need to be monitored to determine if the predictions of Lothian (6) about the 'greenhouse effect' occur. If this does happen droughts as experienced in 1988 will become more common and severe as winter rainfall declines and temperatures rise.

.../21

The current economic conditions which are forcing many farmers to make some risky management decisions are unfortunately beyond their control. However, in the future it seems banks, financial advisers and farmers will need to take a closer look at the possible consequences of major farm mortgages, falls in commodity prices and increases in interest rates in the context of the need to protect the soil resource.

Farmers deeply in debt can only be encouraged to fully utilize the services provided by Rural Counsellors and Government Agencies to ensure they are taking the most financially sound path to their future.

In the near future the potential for improvement in farm management is great and could lead to the adoption of sustainable farming systems which are both economically viable and have a low wind erosion potential. In most cases the technology is known but requires adaptation to suit the particular group of farmers and their environment.

In our opinion the areas of greatest potential improvement are:

1. Adoption of technology which allows the crop to be sown using reduced tillage without the risk of grassy weed competition or root disease.

   This would allow crops to be sown early for maximum yield potential. Modifications to machinery will be required to improve seeding efficiency and reduce soil disturbance. A greater reliance on chemicals for weed control will be required. Improved knowledge of chemical breakdown and residual values will be required to ensure soil build up does not occur.

2. Adoption of feedlotting as a means to quickly reduce grazing pressure is required. Feedlotting could be used not only during droughts but also early in the season as a means of improving early pasture and medic establishment. Farmers will need to be prepared to store or buy fodder as required by the feedlot system.

3. Improved use of land according to its capability, better management of erosion prone soils and improved farm layout.

   Where soils are erosion prone and not suited to wheat and barley cropping patching out of paddocks is required. Unstable deeper sands must be sown with cereal rye or established with permanent pasture or trees. Where possible, re-fencing of sandy farms should be undertaken on a soil type basis so cropping frequency, type and grazing management can be adapted to suit the capability of the soil.

4. Improvement of soil fertility and health by resowing aphid resistant medics and use of fertilizers containing major and trace elements as required.

   Directly this would lead to potentially higher production of crops and pasture and indirectly to improved soil protection through increased organic matter.

.../22

Finally, broad scale tree plantings, while having a marked affect on reducing wind velocity and being aesthically desirable, are expensive to establish and provide no immediate returns. The low return is particularly significant for farmers with scarce financial resources.

During the aerial survey trees, in contrast to the 1977 drought, were not seen to have any direct effect on the degree of wind erosion. It seems that the affect of tillage practices, grazing management and inappropriate land use far outweighed the effect of trees. Careful assessment of the best areas for spending scarce financial resources is essential. In the short term, within paddock management is the key.

The mechanism of transfer of technology to farmers on Eyre Peninsula is crucial to the adoption of the four recommendations above. Farmer groups which set up and assess their own demonstrations are clearly one of the effective means of transferring technology.

This type of activity is likely to provide the most rapid transfer of technology, which will increase both environmental and economic sustainability.

In the 1989/90 season above average autumn rainfall on Eyre Peninsula led to a quick recovery of most bare drifting areas. The erosion scars were quickly covered up and at the end of the 1989/90 season, reportings of record yields were made from some areas.

In 1989/90, Eyre Peninsula as a whole produced 52% of South Australia's wheat and 10% of Australia's wheat in a memorable season.

However, the lessons of 1988/89 will not be forgotten as farmers, Soil Conservation Boards and the local communities progress towards both environmental and economic sustainability.

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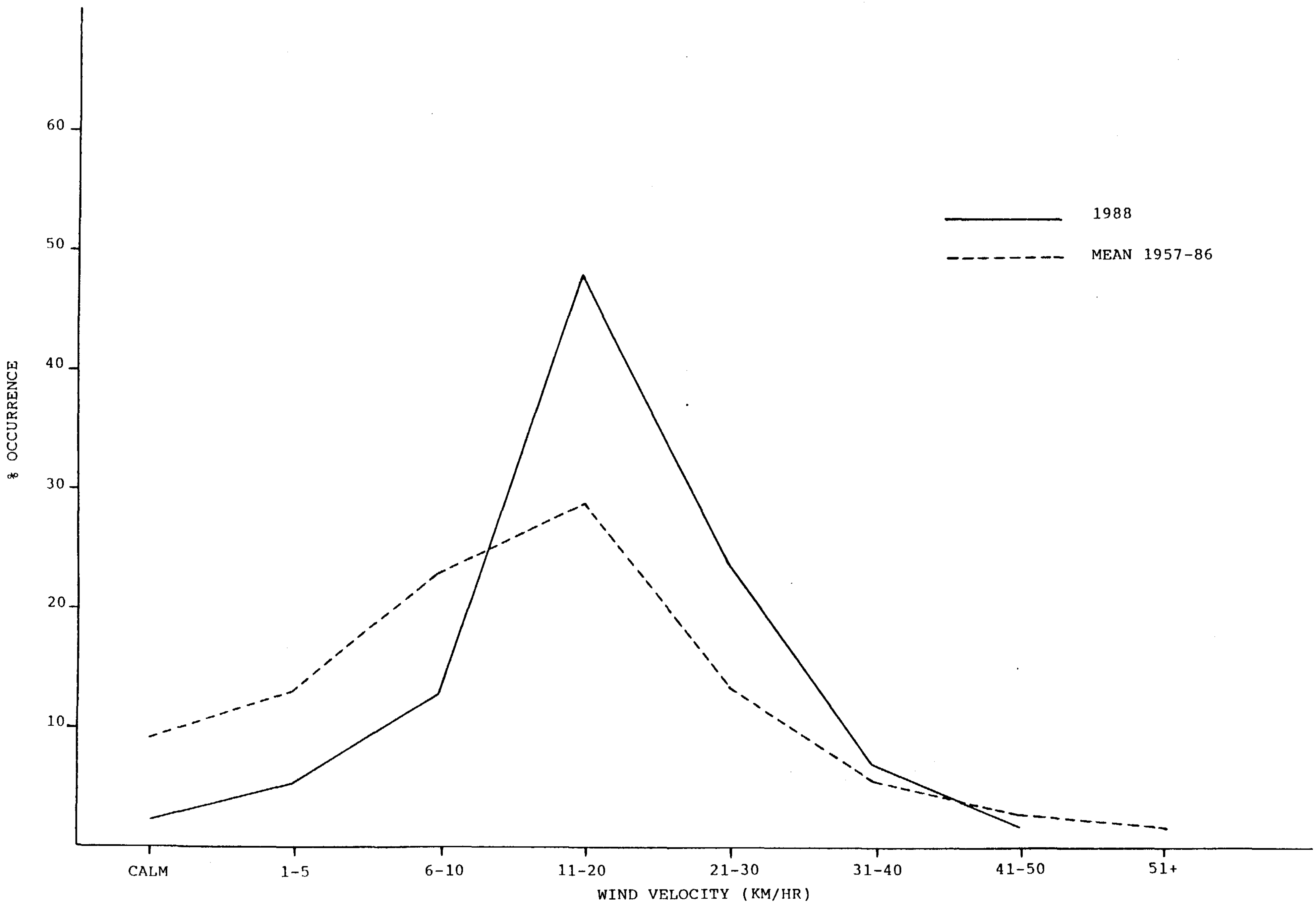
APPENDIX I - Growing Season Rainfall

for Recording Centres on Eyre Peninsula 1988 (mm)

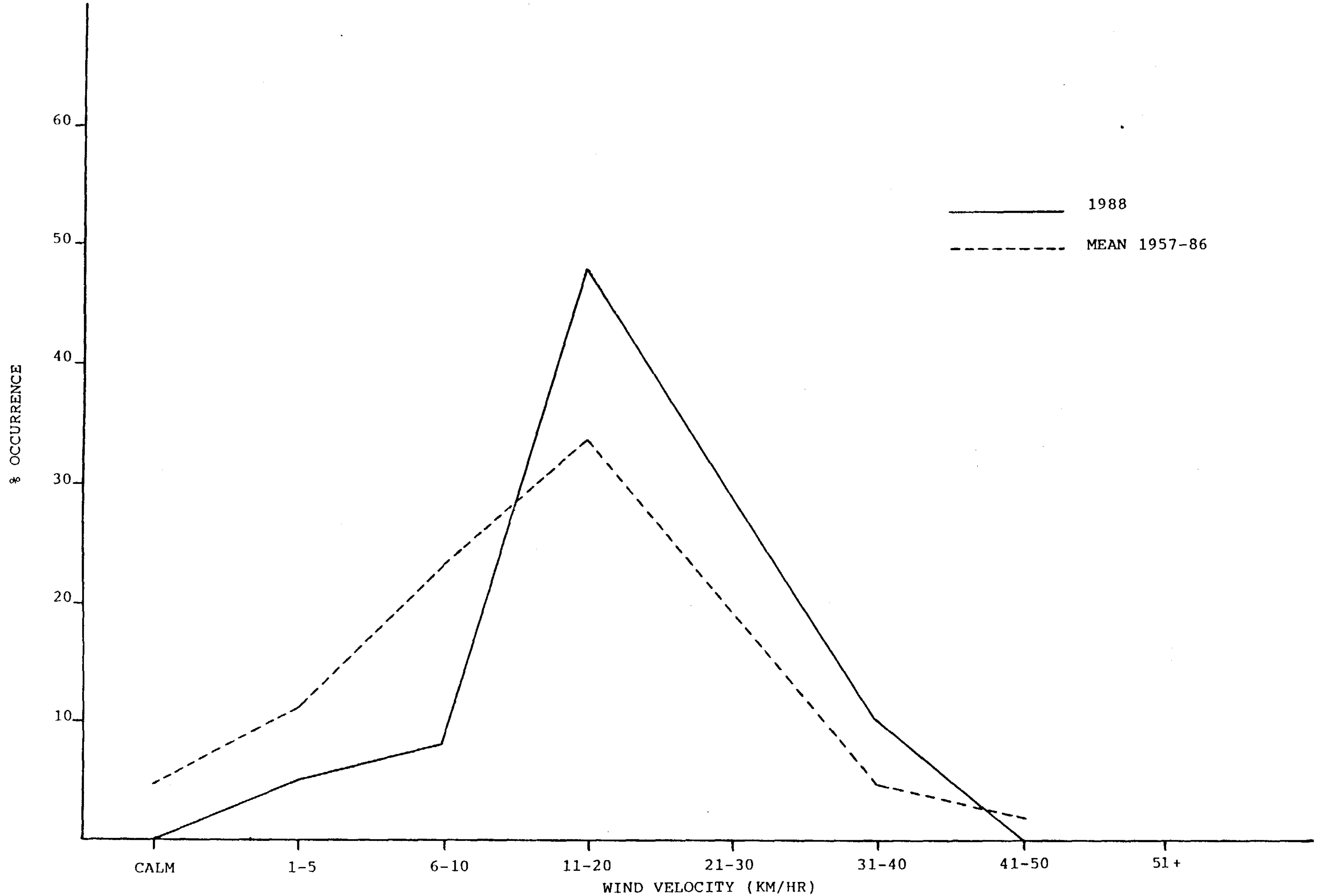
	April	May	June	July	Aug	Sept	Oct	SUM (APR -OCT)	DECILE RANKING
Penong	2.0	32.0	14.0	33.0	4.0	18.0	3.0	106.0	1
Koonibba	0.0	23.0	7.0	15.0	4.0	32.0	3.0	84.0	1
Ceduna	1.0	32.0	17.0	30.0	7.0	20.0	5.0	112.0	1
Smoky Bay	0.4	33.0	32.0	32.0	13.0	24.0	5.0	139.4	2
Wirrulla	0.0	51.0	40.0	38.0	12.0	40.0	7.0	188.0	4
Poochera	0.0	30.0	37.0	46.0	TR	23.0	4.0	140.0	1
Streaky Bay	0.8	37.0	39.0	43.0	21.0	35.0	4.0	179.8	1
Mt Cooper	0.6	53.0	52.0	45.0	19.0	43.0	6.0	218.6	1
Minnipa	0.0	28.0	28.0	31.0	11.0	25.0	6.0	129.0	1
Kyancutta	0.8	26.0	33.0	24.0	6.0	13.0	5.0	107.8	1
Elliston	1.0	36.0	60.0	65.0	12.0	23.0	5.0	202.0	1
Polda	3.0	46.0	60.0	50.0	24.0	38.0	5.0	226.0	1
Lock	0.6	36.0	48.0	38.0	17.0	33.0	5.0	117.6	1
Mt Hope	4.0	65.0	71.0	88.0	33.0	19.0	10.0	290.0	3
Cummins	2.0	58.0	53.0	89.0	27.0	43.0	8.0	278.0	2
Coulta	8.0	103.0	76.0	103.0	40.0	44.0	9.0	383.0	3
Pt Lincoln	7.0	76.0	68.0	99.0	42.0	51.0	13.0	356.0	4
Tumby Bay	2.0	32.0	22.0	47.0	16.0	19.0	2.0	140.0	1
Ungarra	1.0	62.0	49.0	64.0	17.0	28.0	5.0	226.0	2
Pt Neill	4.0	35.0	24.0	32.0	20.0	27.0	4.0	146.0	1
Arno Bay	1.0	23.0	35.0	17.0	11.0	15.0	3.0	105.0	1
Rudall	1.0	30.0	41.0	19.0	15.0	26.0	5.0	137.0	1
Cleve	12.0	47.0	43.0	23.0	21.0	24.0	13.0	183.0	1
Cowell	1.0	20.0	27.0	4.0	6.0	13.0	11.0	82.0	1
Darke Peak	1.0	46.0	39.0	29.0	16.0	39.0	12.0	182.0	1
Kimba	1.0	40.0	31.0	31.0	8.0	31.0	10.0	152.0	2
Buckleboo	1.0	38.0	37.0	28.0	11.0	25.0	13.0	153.0	3

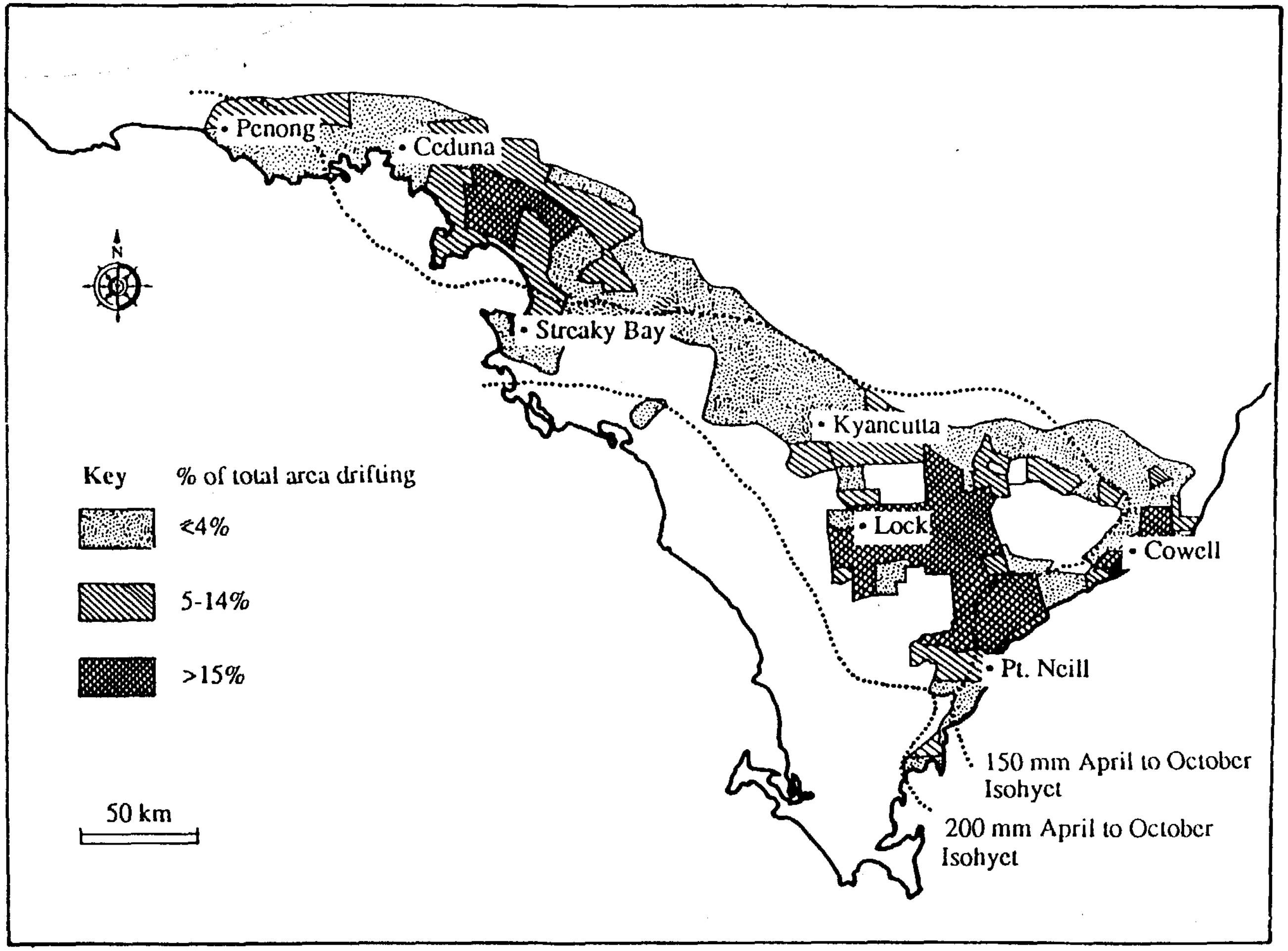
APPENDIX 2

PERCENTAGE OCCURRENCE OF DIFFERENT VELOCITY WIND EVENTS
FOR CLEVE AT 3.00PM DAILY FOR JULY, AUGUST, SEPTEMBER



PERCENTAGE OCCURRENCE OF DIFFERENT VELOCITY WIND EVENTS
FOR CLEVE AT 3.00PM DAILY FOR OCTOBER, NOVEMBER, DECEMBER





Appendix 4: Extent and severity of drift on Eyre Peninsula, May 1978.